Lloyd's Register

Rules and Regulations for the Classification of Special Service Craft, July 2008

Notice No. 4

Effective Date of Latest Amendments:

See page 1

Issue date: December 2008

RULES AND REGULATIONS FOR THE CLASSIFICATION OF SPECIAL SERVICE CRAFT, *July 2008*

Notice No. 4

This Notice contains amendments within the following Sections of the *Rules and Regulations for the Classification of Special Service Craft, July 2008.* The amendments are effective on the dates shown:

Part	***Chapter***	***Section***	***Effective date***
6	2	4	Corrigenda
9	1	3	1 January 2009
10	1	13, 14, 15, 16	1 January 2009
15	1	13	1 January 2009
16	2	6	1 January 2009

It will be noted that the amendments also include corrigenda, which are effective from the date of this Notice.

The *Rules and Regulations for the Classification of Special Service Craft, July 2008* are to be read in conjunction with this Notice No. 3. The status of the Rules is now:

Rules for Special Service Craft	Effective date:	July 2008
Notice No. 1	Effective dates:	1 August 2008 & Corrigenda
Notice No. 2	Effective dates:	1 August 2008 & 1 November 2008
Notice No. 3	Effective dates:	5 August 2008 & Corrigendum
Notice No. 4	Effective dates:	1 January 2009 & Corrigenda

Part 6, Chapter 2
Construction Procedures

CORRIGENDA

■ *Section 4*
Joints and connections

Sub-Section 4.6 *was deleted in error in Notice 2 and has been reinstated in this Notice*.

4.6 Throat thickness limits

4.6.1 The throat thickness limits given in Table 2.4.2 are to be complied with.

Table 2.4.2 remains.

Existing sub-Section 4.6 *to* 4.24 *have been renumbered* 4.7 *to* 4.25.

~~4.6~~ 4.7 Double continuous welding

~~4.7~~ 4.8 Intermittent welding (staggered)

~~4.8~~ 4.9 Intermittent welding (chain)

~~4.9~~ 4.10 Connections of primary structure

~~4.10~~ 4.11 Primary and secondary member end connection welds

~~4.11~~ 4.12 Weld connection of strength deck plating to sheerstrake

~~4.12~~ 4.13 Air and drain holes

~~4.13~~ 4.14 Notches and scallops

~~4.14~~ 4.15 Watertight collars

~~4.15~~ 4.16 Lug connections

~~4.16~~ 4.17 Insert plates

~~4.17~~ 4.18 Doubler plates

~~4.18~~ 4.19 Joint preparation

~~4.19~~ 4.20 Construction tolerances

~~4.20~~ 4.21 Riveting of light structure

~~4.21~~ 4.22 Chemical bonding of structure

~~4.22~~ 4.23 Triaxial stress considerations

~~4.23~~ 4.24 Aluminium/Steel transition joints

~~4.24~~ 4.25 Steel/Wood connection

Part 9, Chapter 1
General Requirements for Machinery

Effective date 1 January 2009

■ *Section 3* Certification of materials

3.1 Materials of construction

3.1.2 Materials used in the construction of machinery and its installation should not be a recognised hazard to personnel. This includes the prohibition of asbestos except in the following applications:
(a) Vanes used in rotary vane compressors and rotary vane pumps.
(b) Watertight joints and linings used for the circulation of fluids when at high temperature (in excess of 350°C) or pressure (in excess of 70 bar (7 MPa)) there is a risk of fire, corrosion or toxicity.
(c) Supple and flexible thermal insulation assemblies used for temperatures above 1000°C.

Part 10, Chapter 1
Diesel Engines

Effective date 1 January 2009

■ *Section 13* Electronically controlled engines

13.1 Scope

13.1.1 The requirements of this Section are applicable to engines for propulsion, auxiliary ~~and~~ or emergency power purposes with software-based electronic control of fuel injection timing and duration, and which may also control air ~~and~~ or exhaust systems.

13.1.2 These engines may be of the slow, medium or high-speed type. They generally have no direct camshaft ~~to drive~~ driven fuel, air ~~and~~ or exhaust systems, but have common rail fuel/hydraulic arrangements and may have hydraulic actuating systems for the functioning of the ~~fuel,~~ air ~~and~~ or exhaust systems.

13.2 Plans and particulars

(*Part only shown*)
13.2.1 In addition to the plans and particulars required by Section 2 the following information is to be submitted:
(b) Details of hydraulic systems for actuation of sub-systems (fuel injection, air inlet ~~and~~ or exhaust), to include details of the design/construction of pipes, pumps, valves, accumulators and the control of valves/pumps. Details of pump drive arrangements are also to be included.
(c) Failure Modes and Effects Analysis (FMEA) of the mechanical, pressure containing and electrical systems and arrangements that support the operation of the engine. The analysis is to demonstrate that suitable risk mitigation has been achieved so that a system will tolerate a single failure in equipment or loss of an associated sub-system such that operation of the engine will not be lost or degraded beyond acceptable performance criteria of the engine. *See* 13.5.
(d) A schedule of testing and trials to demonstrate that the engine is capable of operating as described in the design statement, and any testing required to verify the conclusions of the FMEA. The schedule is to include integration tests to verify that the response of the complete mechanical, hydraulic and electronic system is as predicted for all intended operational modes. The scope of these tests shall be agreed with LR for selected cases based on the FMEA required in (c).
(j) Evidence of type testing of the engine with electronic controls, or a proposed test plan at the engine builders with the electronic controls functioning, to verify the functionality and behaviour under all operating and fault conditions of the electronic control system.

Section 14
Programme for trials of diesel engines to assess operational capability

14.1 Works trials (acceptance test)

14.1.1 Diesel engines which are to be subjected to trials on the test bed at the manufacturer's works and under attendance by the Surveyor(s) are to be tested in accordance with the scope of works trials specified in 14.1.2 to ~~14.1.9~~ 14.1.10. The scope of the trials is to be agreed between the LR Surveyor and the manufacturer prior to testing. At the discretion of the Surveyor, the scope of the trials may be extended depending on the engine application.

14.1.2 For electronically controlled engines integration tests are required, *see* 13.2.1(c).

Existing paragraphs 14.1.2 *to* 14.1.9 *are to be renumbered* 14.1.3 *to* 14.1.10.

Section 15
Type testing procedure for crankcase explosion relief valves

15.1 Scope

15.1.1 To specify type tests and identify standard test conditions using methane gas and air mixture to demonstrate that ~~This test procedure identifies standard conditions by which~~ LR requirements are satisfied for crankcase explosion relief valves intended to be fitted to ~~diesel~~ engines and gear cases ~~can be tested to demonstrate that they satisfy LR requirements for type testing to a defined standard~~.

~~*15.1.2* This test procedure is also applicable to explosion relief valves intended for gear cases.~~

~~*15.1.3* Standard repeatable test conditions have been established using a methane gas and air mixture.~~

~~*15.1.4*~~ *15.1.2* The test procedure is only applicable to explosion relief valves fitted with flame arresters. Where internal oil wetting of a flame arrester is a design feature of an explosion relief valve, alternative testing arrangements that demonstrate compliance with these requirements may be proposed by the manufacturer. The alternative testing arrangements are to be submitted to LR for approval.

14.2 Shipboard trials

Table 1.14.2 Scope of shipboard trials for diesel engines (*Part only shown*)

Main engines driving fixed-pitch propellers (1) (2)		
Trial condition	Duration	Note
At engine speed corresponding to 1,032*R	30 minutes	Where the engine adjustment permits, *see* ~~14.1.6~~ 14.1.7
~~Engines~~ Single main engines solely driving generators for propulsion		
Trial condition	Duration	Note
100 per cent power (rated propulsion power), *see* 14.2.3	≥ 4 hours	(3) (4)
At normal continuous propulsion power	≥ 2 hours	(3) (4)
110% power (rated propulsion power)	30 minutes	
In reverse direction of propeller rotation at a minimum speed of 70 per cent of the nominal propeller speed	10 minutes	(3) (4)
Starting manoeuvres	—	—
Monitoring, alarm and safety systems	—	—

NOTES
1. For main propulsion engines driving controllable pitch propellers, waterjets or reversing gears, the tests for main engines driving fixed-pitch propellers apply as appropriate.
2. Controllable pitch propellers are to be tested with various propeller pitches.
3. The tests to be performed at rated speed with a constant governor setting.
4. Tests are to be based on the rated electrical powers of the electric propulsion motors ~~driven generators~~.

15.3 Test facilities

15.3.1 ~~The test facilities for~~ Test houses carrying out type testing of crankcase explosion relief valves are to meet the following requirements:

(a) The test ~~facilities~~ houses where testing is carried out are to be accredited to a National or International Standard for the testing of explosion protection devices, such as ISO/IEC 17025.

(b) The test facilities are to be acceptable to LR.

(c) The test facilities are to be equipped so that they can ~~control~~ perform and record explosion testing in accordance with this procedure.

(d) The test facilities are to have equipment for controlling and measuring a methane gas in air concentration within a test vessel to an accuracy of ± 0,1 per cent.

(e) The test facilities are to be capable of effective point-located ignition of a methane gas in air mixture.

(f) The pressure measuring equipment is to be capable of measuring the pressure in the test vessel in at least two positions, one at the valve and the other at the test vessel centre. The measuring arrangements are to be capable of measuring and recording the pressure changes throughout an explosion test at a frequency recognising the speed of events during an explosion. The result of each test is to be documented by video recording and~~ if necessary~~, by recording with a heat sensitive camera.

(g) The test vessel for explosion testing is to have documented dimensions~~ that are to be such that its height or length between dished ends is approximately 2 times its diameter but not more than 2,5 times~~. The dimensions are to be such that the vessel is not pipe-like with the distance between dished ends being not more than 2,5 times the diameter. The internal volume of the test vessel is to ~~be determined from the vessel dimensions that~~ include any standpipe arrangements.

(h) The test vessel ~~for explosion testing~~ is to be provided with a flange, located centrally at one end at 90° to the vessel longitudinal axis for mounting the explosion relief valve. The test vessel is to be arranged in an orientation consistent with how the valve ~~it~~ will be installed in service, i.e., in the vertical plane or the horizontal plane. ~~The flange arrangement is to be made approximately one third of the height or length of the test vessel.~~

(j) A circular flat plate ~~having the following dimensions~~ is to be provided for fitting between the pressure vessel flange and valve to be tested with the following dimensions:

1. Outside diameter ~~= 2 x *D* where *D* is~~ of 2 times the outer diameter of the valve top cover. ~~The circular plate is to provide simulation of the crankcase surface.~~
2. Internal bore having the same internal diameter as the valve is to be tested.

(k) The test vessel ~~for explosion testing~~ is to have connections for measuring the methane in air mixture ~~in at least two positions, i.e.,~~ at the top and bottom.

(l) The test vessel ~~for explosion testing~~ is to be provided with a means of fitting an ignition source at a position ~~approximately one third the height or length of the vessel, see~~ as specified in 15.4.3.

(m) The test vessel volume is to be as far as practicable, related to the size and capability of the relief valve to be tested. In general, the volume is to correspond to the requirement in 6.3.1 for the free area of explosion relief valve to be not less than 115 cm^2/m^3 of crankcase gross volume, e.g., the testing of a valve having 1150 cm^2 of free area, would require a test vessel with a volume of 10 m^3. ~~In no case is the volume of the test vessel to vary by more than +15 per cent to -10 per cent from the 115 cm^2/m^3 volume ratio.~~ The following is to apply:

(i) Where the free area of relief valves is greater than 115 cm^2/m^3 of the crankcase gross volume, the volume of the test vessel is to be consistent with the design ratio.

(ii) In no case is the volume of the test vessel to vary by more than ±15 per cent from the design cm^2/m^3 volume ratio.

15.4 Explosion test process

15.4.1 All explosion tests to verify the functionality of crankcase explosion relief valves are to be carried out using an air and methane mixture with a volumetric methane concentration of 9,5 per cent ±0,5 per cent. The pressure in the test vessel is to be not less than atmospheric and is not to exceed ~~0,2 bar~~ the opening pressure of the relief valve.

15.4.3 The ignition of the methane and air mixture is to be made at the centreline of the test vessel at a position approximately one third of the height or length of the test vessel opposite to where the valve is mounted.

15.4.4 The ignition is to be made using a maximum 100 joule explosive charge.

15.5 Valves to be tested

15.5.1 The valves used for type testing (including the testing specified in 15.5.3) are to be ~~manufactured and tested in accordance with procedures acceptable to LR and~~ selected from the manufacturer's ~~usual~~ normal production line for such valves by the LR surveyor witnessing the tests.

15.5.2 For approval of a specific valve size, three valves ~~of that specific size~~ are to be tested in accordance with 15.5.3 and 15.6. For a series of valves, *see* 15.8. ~~The valves are to have been tested at the manufacturer's works to demonstrate that the opening pressure is in accordance with that agreed by the engine builder and valve manufacturer within a tolerance of ± 20 per cent and that the valve is air tight at a pressure below the opening pressure for at least 30 seconds.~~

15.5.3 The valves selected for type testing are to have been previously tested at the manufacturer's works to demonstrate that the opening pressure is in accordance with the specification within a tolerance of ±20 per cent and that the valve is air tight at a pressure below the opening pressure for at least 30 seconds. This test is to verify that the valve is air tight following assembly at the manufacturer's works and that the valve begins to open at the required pressure demonstrating that the correct spring has been fitted.

~~15.5.3~~ 15.5.4 The ~~selection~~ type testing of valves ~~for type testing~~ is to recognise the orientation in which they are intended to be installed on the engine or gear case. ~~Where it is intended that valves be installed in the vertical or near vertical or the horizontal or near horizontal position, then three~~ Three valves of each size are to be tested for each intended installation orientation, i.e. in the vertical and/or horizontal positions.

15.6 Method

15.6.1 The following requirements are to be satisfied at explosion testing:

(a) The explosion testing is to be witnessed by a LR surveyor~~ where type testing approval is required by LR~~.

~~(b) Valves are to be tested in the vertical or horizontal position consistent with the orientation in which they are intended to be installed on an engine or gear case, usually in the vertical position, *see* 15.5.3.~~

~~(c)~~ (b) Where valves are to be installed on an engine or gear case with shielding arrangements to deflect the emission of explosion combustion products, the valves are to be tested with the shielding arrangements fitted.

~~(d) Type testing is to be carried out for each range of valves for which a manufacturer requires LR approval.~~

~~(e)~~ (c) Successive explosion testing to establish a valve's functionality is to be carried out as quickly as possible during stable weather conditions.

~~(f)~~ (d) The pressure rise and decay during all explosion testing is to be recorded.

~~(g)~~ (e) The external condition of the valves is to be monitored during each test for indication of any flame release by video and heat sensitive camera. ~~The test facility is to produce a report on the explosion test findings.~~

15.6.3 **Stage 1.** Two explosion tests are to be carried out in the test vessel ~~with the flange opening fitted~~ with the circular plate as specified in 15.3.1(j) fitted and the opening in the plate covered by a 0,05 mm thick polythene film. These tests establish a reference pressure level for determination of the ~~effects~~ capability of a relief valve in terms of pressure rise in the test vessel, *see* 15.7.1(f).

15.6.4 **Stage 2.**

(a) Two explosion tests are to be carried out on three different valves of the same size. Each valve is to be mounted in the orientation for which approval is sought, i.e., in the vertical or horizontal position with the circular plate described in 15.3.1(j) located between the valve and pressure vessel mounting flange.

(b) The first of the two tests on each valve is to be carried out with a 0,05 mm thick polythene bag, having a minimum diameter of three times the diameter of the circular plate and volume not less than 30 per cent of the test vessel, enclosing the valve and circular plate. Before carrying out the explosion test the polythene bag is to be empty of air. The polythene bag is required to provide a readily visible means of assessing whether there is flame transmission through the relief valve following an explosion. During the test, the explosion pressure will open the valve and some unburned methane/air mixture will be collected in the polythene bag. When the flame reaches the flame arrester and if there is flame transmission through the flame arrester, the methane/air mixture in the bag will be ignited and this will be visible.

(c) Provided that the first explosion test successfully demonstrated that there was no indication of combustion outside the flame arrester and there are no signs of damage to the flame arrester or valve, a second explosion test without the polythene bag arrangement is to be carried out as quickly as possible after the first test. During the second explosion test, the valve is to be visually monitored for any indication of combustion outside the flame arrester and video records are to be kept for subsequent analysis. The second test is required to demonstrate that the valve can still function in the event of a secondary crankcase explosion.

(d) After each explosion, the test vessel is to be maintained in the closed condition for at least 10 seconds to enable the tightness of the valve to be ascertained. The tightness of the valve can be verified during the test from the pressure/time records or by a separate test after completing the second explosion test.

15.7 Assessment and records

(*Part only shown*)

15.7.1 ~~Assessment of the valves after~~ For the purposes of verifying compliance with the requirements of this Section, the assessment and records of the valves used for explosion testing is to address the following:

(e) The pressure rise and decay during an explosion is to be recorded, with indication of the pressure variation showing the maximum overpressure and steady under-pressure in the test vessel during testing. The pressure variation is to be recorded at two points in the pressure vessel.

(f) The effect of an explosion relief valve in terms of pressure rise following an explosion is ascertained from maximum pressures recorded at the centre of the test vessel during the three stages. The pressure rise within the test vessel due to the installation of a relief valve is the difference between average pressure of the four explosions from Stages 1 and 3 and the average of the first tests on the three valves in Stage 2. The pressure rise is not to exceed the limit specified by the manufacturer.

(g) The valve tightness is to be ascertained by verifying from the records at the time of testing that an ~~underpressure~~ under-pressure of at least 0,3 bar is held by the test vessel for at least 10 seconds following an explosion. This test is to verify that the valve has effectively closed and is reasonably gas-tight following dynamic operation during an explosion.

(h) After each explosion test in Stage 2, the external condition of the flame arrester is to be examined for signs of serious damage and/or deformation that may affect the operation of the valve.

(j) After completing the explosion tests, the valves are to be dismantled and the condition of all components ascertained and documented. In particular, any indication of valve sticking or uneven opening that may affect the operation of the valve is to be noted. Photographic records of the valve condition are to be taken and included in the report.

15.8 Design series qualification

15.8.2 The quenching ability of a flame ~~screen~~ arrester depends on the total mass of quenching lamellas/mesh. Provided the materials, thickness of materials, length ~~depth~~ of lamellas/thickness of mesh layer and the quenching gaps are the same, then the same quenching ability can be qualified for different sizes of flame arresters subject to (a) and (b) being satisfied.

(a) $$\frac{n_1}{n_2} = \sqrt{\frac{S_1}{S_2}}$$

(a) $$\frac{A_1}{A_2} = \frac{S_1}{S_2}$$

where

n_1 = total depth of flame arrester corresponding to the number of lamellas of size 1 quenching device for a valve with a relief area equal to S_1

n_2 = total depth of flame arrester corresponding to the number of ~~lamella~~ lamellas of size 2 quenching device for a valve with a relief area equal to S_2

A_1 = free area of quenching device for a valve with a relief area equal to S_1

A_2 = free area of quenching device for a valve with a relief area equal to S_2.

15.8.3 The qualification of explosion relief valves of larger sizes than that which has been previously satisfactorily tested in accordance with 15.6 and 15.7 can be evaluated where valves are of identical type and have identical features of construction subject to the following:

(a) The free area of a larger valve does not exceed three times + 5 per cent that of the valve that has been satisfactorily tested.

(b) One valve of the largest size, subject to (a), requiring qualification is subject to satisfactory testing required by 15.5.3 and 15.6.4 except that a single valve will be accepted in 15.6.4(a) and the volume of the test vessel is not to be less than one third of the volume required by 15.3.1(m).

(c) The assessment and records are to be in accordance with 15.7, noting that 15.7.1(f) will only be applicable to Stage 2 for a single valve.

15.8.4 The qualification of explosion relief valves of smaller sizes than that which has been previously satisfactorily tested in accordance with 15.6 and 15.7 can be evaluated where valves are of identical type and have identical features of construction subject to the following:

(a) The free area of a smaller valve is not less than one third of that of the valve that has been satisfactorily tested.

(b) One valve of the smallest size, subject to (a), requiring qualification is subject to satisfactory testing required by 15.5.3 and 15.6.4 except that a single valve will be accepted in 15.6.4(a) and the volume of the test vessel is not to be more than the volume required by 15.3.1(m).

(c) The assessment and records are to be in accordance with 15.7, noting that 15.7.1(f) will only be applicable to Stage 2 for a single valve.

15.9 The Report

15.9.1 The test ~~facility~~ house is to deliver a full report that includes the following information and documents:

(a) Test specification.

(b) Details of test pressure vessel and valves tested.

(c) The orientation in which the valve was tested (vertical or horizontal position).

(d) Methane in air concentration for each test.

(e) Ignition source.

(f) Pressure curves for each test.

(g) Video recordings of each valve test.

(h) The assessment and records stated in 15.7.

15.10 Approval

15.10.1 ~~Approval~~ The approval of an explosion relief valve is at the ~~prerogative~~ discretion of LR, based on the appraisal of plans and particulars and the test facility's report of the results of type testing.

■ *Section 16* Type testing procedure for crankcase oil mist detection/~~monitoring~~ and alarm ~~arrangements~~ equipment

16.1 Scope

16.1.1 ~~This test procedure identifies standard conditions by which crankcase oil mist detection/monitoring and alarm equipment and systems intended to be fitted to diesel engines can be tested to demonstrate that they satisfy LR requirements for type testing to a defined standard.~~ To specify the tests required to demonstrate that crankcase oil mist detection and alarm equipment intended to be fitted to diesel engines satisfy LR requirements.

16.1.2 This test procedure is also applicable to oil mist detection/~~monitoring~~ and alarm arrangements intended for gear cases.

16.2 Purpose

16.2.1 The purpose of type testing crankcase oil mist detection/~~monitoring~~ and alarm ~~arrangements~~ equipment is sevenfold:

(a) To verify the functionality of the system.

(b) To verify the effectiveness of the oil mist detectors.

(c) To verify the accuracy of the oil mist detectors.

(d) To verify the alarm set points.

(e) To verify time delays between oil mist leaving the source ~~extraction from crankcase~~ and alarm activation.

(f) To verify ~~the operation of alarms to indicate~~ functional failure ~~in the equipment and associated arrangements~~ detection.

(g) To verify ~~that there is an indication when optical obscuration has reached a level that will affect the reliability of information and alarms~~ the influence of optical obscuration on detection.

16.3 Test facilities

16.3.1 ~~The test house~~ Test houses carrying out type testing of crankcase oil mist detection~~/monitoring~~ and alarm equipment ~~and arrangements is~~ are to satisfy the following criteria:

(a) ~~The test facilities are to have the full range of facilities for carrying the type and functionality tests required by this procedure~~ A full range of facilities for carrying out the environmental and functionality tests required by this procedure shall be available and be acceptable to LR.

(b) The test house that verifies ~~that~~ the functionality of the equipment ~~ascertains the levels of oil mist concentration~~ is to be equipped so that it can control, measure and record oil mist concentration levels in terms of mg/l to an accuracy of ±10 per cent in accordance with this procedure.

~~(c)~~ ~~The type tests are to be witnessed by an LR Surveyor unless otherwise agreed.~~

~~(d)~~ ~~The oil mist concentrations are to be ascertained by the gravimetric deterministic method or equivalent. The gravimetric deterministic method is a laboratory process where the difference in weight of a millipore (typically 0,8 μm) filter is ascertained by weighing the filter before and after drawing 1d m³ of oil mist through the filter.~~

~~(e)~~ ~~The results of a gravimetric analysis are considered invalid and are to be rejected if the resultant calibration curve has an increasing gradient with respect to the oil mist detection/monitoring reading. This situation occurs when insufficient time has been allowed for the oil mist to become homogeneous. Single results that are more than 10 per cent below the calibration curve are to be rejected. This situation occurs when the integrity of the filter unit has been compromised and not all of the oil is collected on the filter paper.~~

~~(f)~~ ~~The filters are required to be weighed to a precision of 0,1 mg and the volume of air/oil mist sampled to a precision of 10 ml.~~

16.4 Equipment testing

16.4.2 The range of tests is to include the following for the detectors:

(a) Functional tests described in 16.5.
(b) Electrical power supply failure test.
(c) Power supply variation test.
(d) Dry heat test.
(e) Damp heat test.
(f) Vibration test.
(g) EMC test.
(g) (h) Insulation resistance test.
(h) (j) High voltage test.
(j) (k) Static and dynamic inclinations~~, if moving parts are contained~~.

16.5 Functional ~~test process~~ tests

16.5.1 All tests to verify the functionality of crankcase oil mist detection~~/monitoring devices~~ and alarm equipment are to be carried out in accordance with 16.5.2 to 16.5.6 with an oil mist concentration in air, known in terms of mg/l to an accuracy of ±10 per cent.

16.5.2 The concentration of oil mist in the test ~~vessel~~ chamber is to be measured in the top and bottom of the ~~vessel~~ chamber and these concentrations are not to differ by more than 10 per cent. *See* 16.7.2(a).

16.5.3 The oil mist monitoring arrangements are to be capable of detecting oil mist in air concentrations of between 0 and 10 per cent of the lower explosive limit (LEL), which corresponds to an oil mist concentration of approximately 50 mg/l (15 per cent oil-air mixture) or between 0 and a percentage corresponding to a level not less than twice the maximum oil mist concentration alarm set point.

16.5.4 The ~~operation of the~~ alarm set point ~~indicators~~ for oil mist concentration in air ~~are to be verified and are~~ is to provide an alarm at a maximum setting corresponding to not more than 5 per cent of the LEL or approximately 2,5 mg/l.

16.5.5 Where alarm set points can be altered, the means of adjustment and indication of set points are to be verified against the equipment manufacturer's instructions.

16.5.6 Where oil mist is drawn into a detector~~/monitor~~ via piping arrangements, the time delay between the sample leaving the crankcase and operation of the alarm is to be determined for the longest and shortest lengths of pipes recommended by the manufacturer. The pipe arrangements are to be in accordance with the manufacturer's instructions/ recommendations.

16.5.7 Detector equipment that is in contact with the crankcase atmosphere and may be exposed to oil splash and spray from engine lubricating oil is to be tested to demonstrate that openings do not occlude or become blocked under continuous oil splash or spray conditions. Testing is to be in accordance with arrangements proposed by the manufacturer and agreed by LR.

16.5.8 Detector equipment may be exposed to water vapour from the crankcase atmosphere which may affect the sensitivity of the equipment. It is to be demonstrated that exposure to such conditions will not affect the functional operation of the detector equipment. Where exposure to water vapour and/or water condensation has been identified as a possible source of equipment malfunctioning, testing is to demonstrate that any mitigating arrangements such as heating are effective. Testing is to be in accordance with arrangements proposed by the manufacturer and agreed by LR. This testing is in addition to that required by 16.4.2(e) and is concerned with the effects of condensation caused by the detection equipment being at a lower temperature than the crankcase atmosphere.

16.6 Detectors~~/monitors~~ and alarm equipment to be tested

16.6.1 The detectors~~/monitors~~ and alarm equipment ~~used in~~ selected for the type testing are to be ~~manufactured and tested in accordance with procedures acceptable to LR and~~ selected from the manufacturer's ~~usual~~ normal production line ~~for such equipment~~ by the LR Surveyor witnessing the tests.

16.6.2 Two ~~sets of~~ detectors~~/monitors requiring approval~~ are to be tested. One ~~set~~ is to be tested in the clean condition and the other in a condition ~~that represents~~ representing the maximum ~~degree~~ level of lens obscuration ~~that is stated as being acceptable~~ specified by the manufacturer.

16.7 Method

16.7.1 The ~~following~~ requirements of 16.7 are to be satisfied at type testing~~:~~ .

~~(a)~~ ~~The testing is to be witnessed by a LR Surveyor where type testing approval is required by LR.~~

~~(b)~~ ~~Oil mist detection/monitoring devices are to be tested in the orientation in which they are intended to be installed on an engine or gear case.~~

~~(c)~~ ~~Type testing is to be carried out for each range of oil mist detection/monitoring devices that a manufacturer requires LR approval.~~

~~(d)~~ ~~The test house is to produce a test report.~~

16.7.2 Oil mist generation is to satisfy the following:

(a) Oil mist is to be generated with suitable equipment using an SAE 80 monograde mineral oil or equivalent and supplied to a test chamber having a volume of not less than 1 m^3. The oil mist produced is to have a maximum droplet size of 5 μm. The oil droplet size is to be checked using the sedimentation method.

(b) The oil mist concentrations used are to be ascertained by the gravimetric deterministic method or equivalent. For this test, the gravimetric deterministic method is a process where the difference in weight of a 0,8 μm pore size membrane filter is ascertained from weighing the filter before and after drawing 1 litre of oil mist through the filter from the oil mist test chamber. The oil mist chamber is to be fitted with a recirculating fan.

(c) Samples of oil mist are to be taken at regular intervals and the results plotted against the oil mist detector output. The oil mist detector is to be located adjacent to where the oil mist samples are drawn off.

(d) The results of a gravimetric analysis are considered invalid and are to be rejected if the resultant calibration curve has an increasing gradient with respect to the oil mist detection reading. This situation occurs when insufficient time has been allowed for the oil mist to become homogeneous. Single results that are more than 10 per cent below the calibration curve are to be rejected. This situation occurs when the integrity of the filter unit has been compromised and not all of the oil is collected on the filter paper.

(e) The filters require to be weighed to a precision of 0,1 mg and the volume of air/oil mist sampled to 10 ml.

16.7.3 The testing is to be witnessed by an LR Surveyor where type testing approval is required by LR.

16.7.4 Oil mist detection equipment is to be tested in the orientation (vertical, horizontal or inclined) in which it is intended to be installed on an engine or gear case as specified by the equipment manufacturer.

16.7.5 Type testing is to be carried out for each type of oil mist detection and alarm equipment for which a manufacturer seeks LR approval. Where sensitivity levels can be adjusted, testing is to be carried out at the extreme and mid-point level settings.

16.8 Assessment

16.8.1 Assessment of oil mist detection~~/monitoring devices~~ equipment after testing is to address the following:

(a) The ~~devices~~ equipment to be tested ~~are~~ is to have evidence of design appraisal/approval by LR, *see also* 16.6.1.

(b) ~~The details~~ Details of the detection~~/monitoring devices~~ equipment to be tested are to be recorded. ~~This is to include~~ such as name of manufacturer, type designation, oil mist concentration assessment capability and alarm settings.

(c) After completing the tests, the detection~~/monitoring devices are~~ equipment is to be examined and the condition of all components ascertained and documented. Photographic records of the monitoring ~~devices~~ equipment condition are to be taken and included in the report.

16.9 Design series qualification

16.9.1 The approval of one type of detection~~/monitoring device~~ equipment may be used to qualify other devices having identical construction details. Proposals are to be submitted for consideration.

16.10 The ~~Report~~ report

16.10.1 The test house is to provide a full report which includes the following information and documents:

(a) Test specification.

(b) Details of ~~devices~~ equipment tested.

(c) Results of tests.

16.11 Acceptance

16.11.1 Acceptance of crankcase oil mist detection~~/monitoring devices is the prerogative~~ equipment is at the discretion of LR, based on the appraisal of plans and particulars and the test house report of the results of type testing.

16.11.2 The following information is to be submitted to LR for acceptance of oil mist detection~~/monitoring~~ equipment and alarm arrangements:

(a) Description of oil mist detection~~/monitoring~~ equipment and system including alarms.

(b) Copy of the test house report identified in 16.10.

(c) Schematic layout of engine oil mist detection~~/monitoring~~ arrangements showing location of detectors/sensors and piping arrangements and dimensions.

(d) Maintenance and test manual which is to include the following information:
- Intended use of equipment and its operation.
- Functionality tests to demonstrate that the equipment is operational and that any faults can be identified and corrective actions notified.
- Maintenance routines and spare parts recommendations.
- Limit setting and instructions for safe limit levels.
- Where necessary, details of configurations in which the equipment is and is not to be used.

Part 15, Chapter 1
Piping Design Requirements

Effective date 1 January 2009

■ *Section 13*
Requirements for flexible hoses

13.2 Applications for rubber hoses

13.2.3 Rubber ~~or plastics~~ hoses, with single, ~~or~~ double or more closely woven integral wire braid or other suitable material reinforcement, or convoluted metal pipes with wire braid protection, may be used in bilge, ballast, compressed air, fresh water, sea-water, oil fuel, lubricating oil, Class III steam, hydraulic and thermal oil systems. Flexible hoses of plastics materials for the same purposes, such as Teflon or Nylon, which are unable to be reinforced by incorporating closely woven integral wire braid are to have suitable material reinforcement as far as practicable. Where rubber or plastics hoses are used for oil fuel supply to burners, the hoses are to have external wire braid protection in addition to the integral wire braid. Flexible hoses for use in steam systems are to be of metallic construction.

Part 16, Chapter 2
Electrical Engineering

Effective date 1 January 2009

■ *Section 6*
System design – Protection

6.5 Circuit-breakers

6.5.1 Circuit-breakers for alternating current systems are to satisfy the following conditions:

(a) the r.m.s. symmetrical breaking current for which the device is rated is to be not less than the r.m.s. value of the a.c. component of the prospective fault current, at the ~~first half cycle~~ instant of contact separation (i.e. first half cycle, or time of interruption where an intentional time delay is provided to ensure suitability);

(b) the peak asymmetrical making current for which the device is rated is not to be less than the peak value of the prospective fault current at the first half cycle, allowing for maximum asymmetry;

(c) the power factor at which the device short circuit ratings are assigned is to be no greater than that of the prospective fault current; alternatively for high voltage, the rated percentage d.c. component of the short-circuit breaking current of the device is to be not less than that of the prospective fault current.

~~*6.5.4* To satisfy 6.5.3, the rated service short-circuit breaking capacity of low voltage circuit-breakers:~~

- ~~directly connected to main or emergency switchboard; and/or~~
- ~~installed in the feeder lines for circuits used to provide essential or emergency services;~~

~~is to be not less than the prospective fault current referred to in 6.5.1(a). Low voltage circuit-breakers for other circuits may be selected on the basis of their rated ultimate short circuit breaking capacity.~~

~~*6.5.5* The rated short time withstand current of low voltage circuit-breakers which are required to have an intentional short time delay under short circuit conditions to ensure discriminative action with respect to other protective devices is to be not less than the r.m.s. value of the a.c. component of the prospective fault current, at the first half cycle.~~

6.5.4 Circuit- breaker selection is, and ratings are, to be in accordance with the relevant requirements of IEC 60092-202: *Electrical installations in ships – System design – Protection*. Alternative methods acceptable to LR of selecting suitable circuit-breakers may be considered.

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